

The seal of the Department of Defense, United States of America, is a circular emblem. It features a blue outer ring with the words "DEPARTMENT OF DEFENSE" at the top and "UNITED STATES OF AMERICA" at the bottom in white capital letters. Inside the ring is a light blue field containing a bald eagle with its wings spread, facing left. The eagle's chest is covered by a shield with vertical red and white stripes and a blue top section. Above the eagle's head are thirteen yellow stars arranged in an arc, with white rays emanating from behind them. 

# **Software-Intensive Systems Producibility Initiative**

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# Software Criticality Rising

There are precious few interesting man-made systems whose success is not critically dependent on **software**.

Twenty years from now, **software** people will be sitting at the table and the other disciplines will be sitting around the sides of the room.

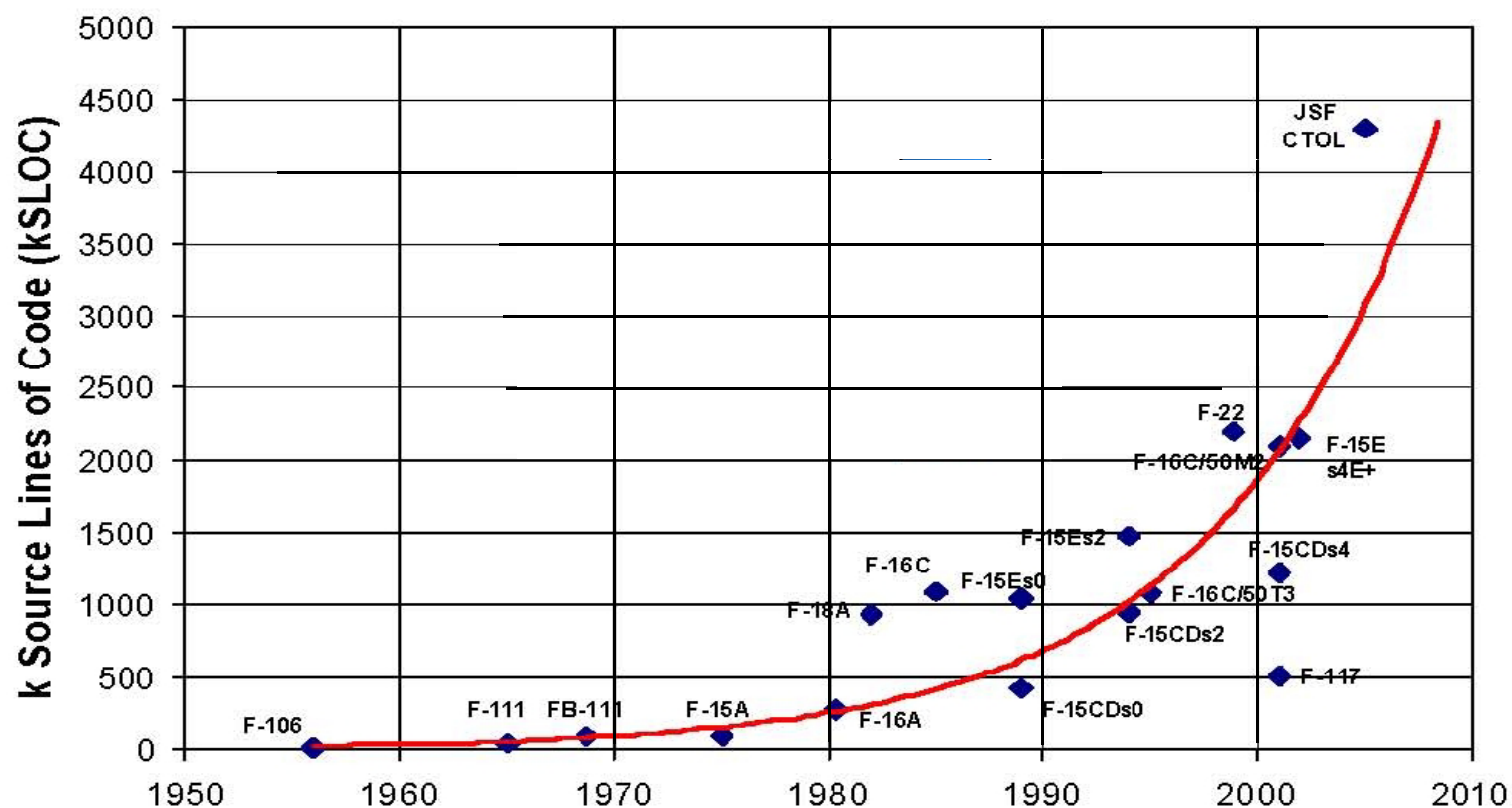
*Eberhardt Rechtin, 1993*

As complexity grows, the ability of systems and **software** engineers to consider all of the secondary and tertiary effects of their decision making becomes more and more difficult; the time required to make the decisions grows with the complexity.



# DoD Software is Growing in Size and Complexity

Total Onboard Computer Capacity (OFP)



•Source: "Avionics Acquisition, Production, and Sustainment: Lessons Learned -- The Hard Way", NDIA Systems Engineering Conference, Mr. D. Gary Van Oss, October 2002.



# The Proposed Initiative

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- Support and coordinate **research and development** in the **accelerated production** of successful complex, software-driven systems
  - Life-cycle, sustainability, manageability, quality
  - Architectures, modeling, requirements
  - **Not just** faster code development
- Leverage the Service Labs, DARPA, OSD, FFRDCs, NSF, NIST, NAS
- Currently engaging the new administration



# Software Development Tools And Technology Information Clearinghouse (SDTATIC)

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- Created/Hosted by Data Analysis Center for Software



- Central and searchable source of information on software development tools and technology
- Tools categorized by a taxonomy related to the SEI's SISPI Technology Roadmap
- [www.stdatic.com](http://www.stdatic.com)



# Software PProdUcibility Collaboration and Evaluation Environment (SPRUCE)

- **Managed by the Air Force**
- **Open collaborative research and development environment**
  - Demonstrate, evaluate, and document the ability of novel tools, methods, techniques, and technologies
- **Facilitate testing of Software-Intensive Systems**  
**Producibility research products and methods**
- **Provide a realistic environment for research of DoD embedded systems and software**
- **Provide an ability for university and industry leverage of technology development**
- **Support successful technology transition and transfer**
- **Facilitate collaborate of researchers and major defense acquisition program developers as well as analyzing the utility of tools**



**Note:** SPRUCE was originally the Systems and Software Test Track (SSTT)





# SPRUCE Status

## SPRUCE BETA

Systems and Software Producibility  
Collaboration and Experimentation Environment

- **Kickoff** – April 2008
- **Spiral 0** – June 2008
  - Out-of-the-box (OOTB) capabilities
- **Spiral 1** – August 2008
  - OOTB customization of fundamental capabilities – *SPRUCE beta*
- **Spiral 2** – June 2009
  - SPRUCE populated with four additional challenge problems (Dec 2008)
  - Customized collaboration and workflow enhancements
    - Tighter integration between SPRUCE operations portal and experiment infrastructure
- **Spiral 3** – June 2010
  - Usage patterns, benchmarking and trend intelligence
    - Track usage metrics
    - Track and report affinities between researchers, problems, solutions and tools



# Early SPUCE Challenge Problems

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- **Predicting Computer System Capacity Needs**
  - A modern computing architecture consists processors, memory, bus controllers, bridges, arbiters, DMA controllers and other components.
  - The total behavior of the system depends on the processor configuration, the software load & the message load on the system collectively
  - A predictive model is needed that incorporates these elements into an environment suitable for trade studies & processor system specification
- **Seed Challenge Problem Instances**
  - Predicting Performance of Avionics Mission Systems Using a Logical Task Network & Computing Plant Description
  - Optimization Techniques for Deployment of Avionics Mission Systems onto a Specific Computing Plant
  - Sponsored by Lockheed Martin Aeronautics
  - Seeking Experiment Ready Solution for F-35 & F-22 programs





# Systems and Software Stockroom (S3)

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- **Joint Navy and Air Force BAA**
  - Facilitate development of an open, community-driven, technically focused, shared infrastructure of software artifacts, domain knowledge and expertise in order to improve the capability to produce software for DoD systems
  - Modeled after Vector Signal Image Processing Library (VISPL)
- **Competitive Prototype Acquisition Model**
  - 6 months to produce a prototype and documentation
  - 36 Month Phase II



# OSD/Navy SBIR Projects

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- **Software Hub SBIR**
  - Open standard language linking software analysis and development tools
  - Reactive Systems, Inc. in Phase II of the SBIR
- **Error Handling SBIR**
  - Approaches and tools to analyze existence, completeness, and adequacy of error handling policies and paths
  - WW Technology Group completed Phase II of the SBIR and are funded to apply their technology to two sub programs



# Army Software Technologies for Interoperable Systems of Systems

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- **Develop and establish principles of interoperability and complexity management**
  - Foundation for developing a service-oriented architecture for ultra large scale systems
- **Two awards**
  - UC Berkeley
  - Vanderbilt University



# Army Award (UC Berkeley)

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- **Composition of systems based on**
  - Integration technologies for legacy and custom subsystems that provide an understanding of the interaction of subsystems;
  - Scalable composition mechanisms for system-of-systems architectures;
  - Interface formalisms through which compatibility and properties of compositions can be determined from properties of the subsystems;
  - Ontology models for the organization of components together with a semantic type system for the data on which they operate; and
  - Hybrid models for designing and analyzing the dynamics of subsystem interactions with their physical environment



# Army Award (Vanderbilt)

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- **Enable system architects and integrators in creating large-scale SOA-based systems on Mobile Ad hoc Networks (MANET)**
  - “Model-based tools for Service Architectures on Mobile Ad hoc Networks.” (MOSAMAN)
- **Emphasis on model-based approaches**
  - Service Oriented Architecture middleware and
  - Applications on MANET platforms
- **Results and deliverables include**
  - Domain-specific modeling environments
  - Analysis tool chains, and
  - Architecture analysis tradeoffs



# Ongoing and Future Activities

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- **SEI Roadmap** (Grady Campbell)
- **National Science Foundation Cyber-Physical Systems initiative** (Helen Gill)
  - Solicitation NSF 08-611
  - Int'l Workshop June 22, 2009 in Montreal  
[\(http://www.cs.mcgill.ca/~xueliu/Confs/WCPS2009/\)](http://www.cs.mcgill.ca/~xueliu/Confs/WCPS2009/)
- **National Academy of Sciences study** (Bill Scherlis)
  - “Advancing Software Intensive Systems Producibility” (ASISP)
  - Letter report delivered and available on-line
- **New Systems Engineering Research Center UARC at Stevens Institute** (Dinesh Verma/Art Pyster)





# ASISP Letter Report Summary

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- **To what extent is software capability important for DoD?**
  - *Software capability provides strategic advantage to DoD*
  - *The role and significance of software will continue to expand*
- **Will the advances in software producibility needed by DoD emerge unaided from the defense industrial base at a pace sufficient to meet evolving defense requirements?**
  - *DoD's needs will not be met by relying only on its own demand pull, plus technology push from commercial innovation*
- **In which technologies should DoD invest in research to advance software producibility?**
  - *There is a clear rationale for DoD research investment in technology areas where DoD has leading demand*
  - *Three areas of significance:*
    - *Management of engineering risk in unprecedented ultra-scale systems*
    - *Software assurance and early and continuous validation*
    - *Management of requirements-related risk with minimal sacrifice of capability*



# SERC Vision and Perspective

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## ***Vision***

**DoD and IC systems achieving mission outcomes – enabled by research leading to transformational SE methods, processes, and tools.**

## ***Perspective***

The SERC will be the primary engine for defense and intelligence community SE basic research. In doing so, the SERC will:

- 1.Transform SE practice throughout the DoD and IC communities by creating innovative methods, processes, and tools that address critical challenges to meeting mission outcomes (*what*),
- 2.Become the catalyst for community growth among SE researchers by enabling collaboration among many SE research organizations (*who*),
- 3.Accelerate SE competency development through rapid transfer of its research to educators and practitioners (*how*).



# Who is in the SERC?

## Lead University



## Principal Collaborator



## Collaborators

- Auburn University
- Air Force Institute of Technology
- Carnegie Mellon University
- Fraunhofer Center at UMD
- Massachusetts Institute of Technology
- Missouri University of Science and Technology (S&T)
- Naval Postgraduate School
- Pennsylvania State University
- Southern Methodist University
- Texas A&M University
- Texas Tech University
- University of Alabama in Huntsville
- University of California at San Diego
- University of Maryland
- University of Massachusetts
- University of Virginia
- Wayne State University

As the DoD *Systems Engineering Research-University Affiliated Research Center*, SERC will be responsible for systems engineering research that supports the development, integration, testing and sustainability of complex defense systems, enterprises and services. Its members are located in 11 states, near many DoD facilities and all DAU campuses.



# Questions?

